

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.: 10/797,938 Confirmation No.: 4873
Applicant(s): Douglas R. Svenson, Jian Li
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Art Unit: 1623
Examiner: White, Everett
Title: PROCESS FOR MANUFACTURING HIGH PURITY XYLOSE

Docket No.: 046088/267693
Customer No.: 00826

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

July 25, 2008

DECLARATION OF DR. JIAN LI UNDER 37 C.F.R. § 1.132

Sir:

I, Jian Li, hereby declare and state that:

1. I am one of the inventors of the claimed invention of the above-identified U.S. Patent Application Serial No. 10/797,938, titled "Process for Manufacturing High Purity Xylose" (hereinafter referred to as "the Application"). I am currently employed by Rayonier, Inc. the assignee of the above-identified application, and have been at all times during and following the invention described by the Application.

2. I have studied and worked in the area of paper and pulp processes including pulp and fiber strength and have considerable experience in this field. Since December 2000 to the present time, I have been conducting research on the in-line control of the kraft pulping kinetics, and the physical chemistry of the alkaline hemicellulose solutions at Rayonier Research Center. I obtained a Ph.D.

degree in Chemical Engineering from McGill University, Montreal in December 1989; a Master of Engineering degree in Chemical Engineering from McGill University; and a Bachelor of Engineering degree from Tianjin Institute of Light Industry, China. From 1990 to 1997, I was employed with Pulp and Paper Research Institute of Canada (PAPRICAN), first as Assistant Scientist, then Associate Scientist, and eventually was promoted to Scientist. In December 1997, I joined the Institute of Paper Science & Technology in Atlanta, GA as an Associate Professor of Chemical Engineering where I conducted research and teaching until December 2000. A significant amount of my research during the 10 years I was at PAPRICAN and the Institute of Paper Science and Technology was directed towards the effect of hemicellulose change due to pulping, bleaching, and yield improvement on paper pulp fiber physical strength. I have published numerous articles in some of the most prestigious scientific journals in this research field, including *Journal of Pulp & Paper Science*; *TAPPI Journal*; *The Canadian Journal of Chemical Engineering*; *Chemical Engineering Science*, *Environmental Science & Technology*; and *Industrial Engineering Chemistry Research*. I have also presented conference papers in many of the most significant conferences in the Chemical Engineering and Pulp & Paper Science field, including the International Symposium on Wood and Pulping Chemistry, the CPPA Annual Conference and the TAPPI Pulping Conference. I am also a coinventor in 5 U.S. patents. A list of the various publications that I have authored or have coauthored is provided in the appendix.

3. I have reviewed the Office Actions dated March 25, 2008, including the basis of rejection of Claims 1 – 48 as being obvious over a combination of US Patent No. 6,512,110 to Heikkila et al. and U.S. Patent No. 4,294,654 to Turner.

4. I disagree with the assertions set forth in the Office Action dated March 25, 2008 that it would be obvious to one of ordinary skill in the art to substitute the

pulp used in the process for the production of xylose from hardwood pulp of the Heikkila patent with the prehydrolyzed pulp of Turner. In particular, as a person having a high level of skill in the art to which these patents pertain, I believe that the Examiner's rationale for asserting that it would be obvious to use Turner's pulp in the method/system of Heikkila is based on an incorrect or incomplete understanding of the teachings of these references, and is therefore incorrect.

5. Heikkila is concerned with a process for the preparation of xylose from a paper-grade hardwood pulp which includes treating the pulp with a xylanase enzyme treatment. See Abstract. Heikkila also repeatedly emphasizes that the process is directed to extraction of xylose from paper-grade pulp. See for example, Abstract; Column 1, line 8 – 12; column 5, lines 14 – 16; Examples 1 – 21 and the Claims. In particular, Heikkila emphasizes that the xylanase treatment “improves the quality of the pulp for use as a source of xylan in that it improves the solubility of xylan whereby xylan is more easily removed from pulp. This results in increased recovery of xylan and, accordingly, higher yields of xylose. Without being bound to the theory, these improvements are believed to have their basis in the increased solubility of xylan, which is caused by the xylanase treatment.” See column 5, lines 5 – 13. A further objective of Heikkila's process is the production of a dissolving grade pulp. For example, Heikkila states “the xylanase treatment results in a simultaneous production of dissolving-grade pulp of very high quality and high yields of xylose.” See column 5, lines 43 – 49, see also Column 9, lines 15 – 19.

6. Turner on the other hand is directed to a completely different and unrelated process than that of Heikkila. Specifically, Turner is directed to a process of delignification (i.e., removal of lignin from unbleached pulp) and bleaching of lignocellulosic pulp using a photo-oxygenation reaction. See column 2, lines 45 – 52. In particular, Turner teaches a process in which a stream of

oxygen gas is introduced into a lignocellulosic pulp slurry. See column 3, lines 51 – 53. The pulp slurry is then irradiated with ultraviolet light that delignifies and bleaches the lignocellulosic pulp. See column 4, lines 1 – 27. In other words, Turner teaches a process for removing lignin from prehydrolyzed pulp using oxygen and ultraviolet light.

7. One of ordinary skill in the art would not be motivated to combine Heikkila with Turner. First, Heikkila is directed to an entirely different field of application from the objective and purpose of Turner. As noted in paragraph 5, Heikkila is directed to a process of recovering xylose from paper grade pulp. This is quite different from the problem addressed by Turner, namely the delignification and bleaching of lignocellulosic pulp using oxygen with the aid of ultraviolet light. In fact, Turner is completely silent with respect to the recovery of xylose. Because of the significant differences to which these patents are directed, a person of ordinary skill in the art would not consider using the prehydrolyzed pulp mentioned by Turner in the xylanase enzyme treatment process of Heikkila.


8. Second, one of the preferred objectives of the process of Heikkila is to produce a dissolving grade pulp. That is, the end product of Heikkila's process is the simultaneous production of both xylose and a dissolving grade pulp. As such, one of ordinary skill in the art would not select the use of a dissolving grade pulp (i.e., the prehydrolyzed pulp of Turner) as a starting product in the process of Heikkila. It would serve no purpose to modify the Heikkila process to include a desired end product as a starting product. Accordingly, one of skill in the art would not be motivated to modify the process of Heikkila to substitute a paper grade pulp with the prehydrolyzed pulp of Turner.

9. Third, and as set forth in my Declaration of October 31, 2007, substituting a prehydrolyzed pulp for a paper grade pulp in the process of Heikkila would result in significant loss of pulp viscosity, which would render the resulting pulp unusable. The pulp viscosity, or IV, is a measure of the cellulose chain length, the higher IV, the longer the chain. For paper grade pulp, since it contains 15 - 20% short chain hemicellulose, the IV value of the pulp is a measure of the average of the mixture of cellulose and hemicellulose. Accordingly, when hemicellulose is removed from the pulp without degrading the cellulose, the resulting pulp will have a higher IV value than the starting pulp. In the case of the paper grade pulp used in the examples of Tables I - III, the cellulose chain should be greater than what is expected based on an IV of 7.97 (see column 8, line 41). As such, when hemicellulose is removed from the pulp without degrading the cellulose, it would be expected that the resulting pulp would have a higher IV because of the increase in cellulose concentration. However, based on the values shown in Tables I - III of Heikkila, the IVs of the treated pulp were predominately lower, and in some cases significantly lower, mostly because of the repeat treatment by the strong warm caustic and enzyme. This IV loss is probably fine when starting with a paper grade pulp with high IVs. However, a prehydrolyzed pulp after cooking has a relatively low IV already, generally below 7.0. As such, if a prehydrolyzed kraft pulp, such as the one described in Turner, is treated in accordance with Heikkila's process, the resulting pulp would have an IV that would be too low to be used as a dissolving grade pulp. Accordingly, one of ordinary skill in the art would avoid using a prehydrolyzed pulp, such as that disclosed in Turner, in the process of Heikkila.

10. I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or

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both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application of any patent issued thereon.



Jian Li Ph.D

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Appendix

- 1) List of publications authored by Dr. Li**

Publications authored by Dr. Li

1. Journal Publications

J. Samps, J. Li, "How does mass transfer affect the effectiveness of AQ", **Appita J.**, Vol 57 No 2, p.132-136, 2004.

C. Luthé, R. Berry, J. Li, "Polysulfide for yield enhancement in sawdust pulping: Does it work?" **Pulp & Paper Canada**, p. 32-37, 105(1), 2004

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X-S. Chai, Zhu, J.Y., and Li, J., Simultaneous and Rapid Analysis of Hydroxide, Sulfide, and Carbonate in Kraft Liquors by UV-Attenuated Total Reflection Spectroscopy", **J. Pulp & Paper Sci.**, 28(4), 105-109, 2002.

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K. Goel, T. Radiotis, R. Eisner, G. Sherson, J. Li, "Switchgrass: a potential pulp fibre source,"**Pulp & Paper Canada**, 101:6, p.41-45, 2000.

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J. Li, M. MacLeod, R. Berry, J. McPhee, "Improving extended delignification technology for kraft pulping, Part II: Co-current two-stage continuous cooking ", **Pulp and Paper Canada**, vol. 100, No. 11, p.48, 1999.

J. Li, C. Mui, "Effect of lignin diffusion on kraft delignification kinetics as determined by liquor analysis. Part I: An experimental study", **J. Pulp & Paper Sci.**, vol.25, No.11, p.373, 1999.

T. Radiotis, J. Li, K. Goel, R. Eisner, "Fiber characteristics, pulpability, and bleachability of switchgrass," **Tappi J.**, vol. 82, No. 7, p.100, 1999.

Z. Li, H. Ma, G. Kubes, J. Li, "Synergistic Effect of Kraft Pulping with Polysulphide and Anthraquinone on Pulp Yield Improvement", **J. Pulp & Paper Sci.**, vol. 24, No.8, p.237, 1998.

J. Li, A. Phenix, M. MacLeod, "Diffusion lignin macromolecules within the fibre walls of kraft pulp. Part I: Determination of the restricted diffusion coefficient under alkaline conditions", **Canadian J. Chemical Engineering**, vol. 75, No.1, p.16, 1997.

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2. Patents

J. Li, S. Boller, "Cellulosic fiber pulp and highly porous paper products produced therefrom", **US Patent No. 7,285,184, October 23, 2007**.

O. Ali, J. Cenicola, J. Li, J. Taylor, "Process for producing alkaline treated cellulosic fibers", **US Patent, No. 6,896,810, May 24, 2005**.

C. Luthe, J. Li, R. Berry, "Improved Pulping Process", **US Patent, No. 6,153,052, Nov. 28, 2000**.

J. Li, "Two stage kraft cooking", **US Patent, No. 5,522,958, June 4, 1996**.

A.R.P. van Heiningen, J. Li, and J. Fallavollita, "Low temperature recovery of kraft black liquor", **US Patent, No. 5,174,860, Dec. 29, 1992. (= Can. Patent, No. 1,313,577, Feb. 1993.)**

O. Ali, J. Li, S. Rogers, "Method of concentrating pulp mill extracts", **US patent application**, No. 20,060,016,751, Jan. 26, 2006

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3. Representative Conference Publications

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